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### Mixing capsule with forced activation

The invention relates to a mixing capsule for a two-component mixture, as well as to a method for its forced activation.

A multitude of different mixing capsules are known in the state of the art, which are used for the manufacture of a quickly curable mass of at least two initial components. A common feature of these mixing capsules is the presence of two chambers which serve for the storage of the initial components of a rapidly polymerisable two-component mixture.

A mixing capsule with a mixing chamber is known from DE 43 15 920, with which a hollow piston is guided in a container part in a slidingly movable manner. In turn, a punch is slidingly movable in the hollow piston. The container part has an end-face with a discharge opening for pressing out the multi-component mixture. A mixing chamber is defined by the hollow piston which is arranged at a distance to the end-face of the container part when the mixing capsule is filled.

In the initial condition, the mixing chamber is separated from the inner space of the hollow piston by way of a film which is bonded onto an annular projection of the hollow piston. The film has a predetermined break location whose holding strength is smaller than the strength of the bonding connection, so that on activation of the capsule by way of pressing in the punch, the film tears at the predetermined break location and the fluid may flow into the mixing chamber. The fluid is pressed into the mixing chamber by way of reducing the inner space of the hollow piston with the punch. The punch has the same length as the hollow piston, so that on reaching the end position in the hollow piston, the punch may no longer be further displaced without also displacing the hollow piston. So that the hollow piston is not inadvertently pushed into the mixing chamber on pressing the fluid into the mixing pressure by way of pressure on the punch, the hollow piston comprises a relief into which a manually removable, U-shaped locking member engages, and thus locks the hollow piston with respect to the container part forming the mixing chamber.

After the mixing of the fluid component with the powder-like component present in the mixing chamber by way of a shaking mixer, pressure is exerted on the punch and the hollow piston together for discharging the obtained dental mass. Thereby, there is effected a sliding movement between the hollow piston and the punch on the one hand, and the mixing chamber on the other hand.

DE 39 20 537 C2 described a multi-component mixing capsule with a container part which forms a cylindrical mixing chamber. The mixing chamber is terminated in the axial direction on the one hand by way of a closure wall comprising an ejection opening, and on the other hand by way of a hollow piston. The hollow piston is terminated towards the mixing chamber with a holed wall. A punch is displaceable in the inside of the hollow piston in a translatory manner. The hollow piston and the cylindrical mixing space thus form two beaker-like receptacles for two components to be mixed, which are pushed into one another, wherein of the two receptacles, the beaker edges on the one hand and the holed wall or closure wall on the other hand are directed equally.

In the basic position, the hollow piston projects with its beaker edge beyond the beaker edge of the container part. The hollow piston comprises a projection on the beaker edge, via which forces acting on the hollow piston are diverted to the container part. On activation of the capsule, this projection serves for enabling the fluid component in the hollow piston to be

pressed with the punch out of the hollow piston through the holed wall into the mixing chamber in the container part without the hollow piston at the same time displacing relative to the container part.

The fluid component is present in a film container in the hollow space of the hollow piston. By way of pressure on the punch, the fluid is set under pressure until the film container breaks open and the fluid flows over through the hole in the holed wall into the mixing chamber. If the punch is present at the holed wall, the fluid component is completely brought together with the powder-like component present in the mixing chamber, and the two components may then be mixed by way of shaking.

Subsequently, for pressing out the dental mass, the punch together with the hollow piston is displaced in the container part, so that the mixing chamber is reduced in size. Thereby, the projection at the beaker edge of the hollow piston is dislocated or torn away. As a result of this, the mixture is discharged through the ejection opening.

It is the object of the present invention to provide a mixing capsule with which, on the one hand, any unintended activation is rendered impossible, but on the other hand an activation is required in a forced manner so that the mixing capsule may be applied.

According to the invention, a capsule is characterised in that

- a sleeve open at least on one side is provided, which may be placed onto the mixing capsule,
- that an abutment surface for the axially displaceable activation means is formed on the sleeve,
- that at least one U- or V-shaped guide path with a first and second end as well as at least one guide element, e.g. a projection or protrusion, is formed on the mixing capsule and on the sleeve,
- that the first end of the guide path defines an access and the second end an abutment for a guide element, and
- that the guide element may engage into the guide path of the sleeve, wherein when the mixing capsule is filled, the guide element is located on the abutment of the guide path, so that on removing the sleeve this must move in an activation direction forwards and backwards, and thereby actuates the activation means.

The mixing capsule according to the invention has the great advantage that an activation, i.e. a bringing-together of the initial components stored in the two receptacles is effected in a forced manner when the sleeve is removed. Furthermore, the mixing capsule has the advantage that the sleeve may function as a transport securement and renders impossible any unintended activation.

Although, as a rule, the guide path may be different and in particular may either be provided on the sleeve or on the mixing capsule, the guide path is preferably provided on or in the sleeve. Thereby, the guide path may be designed as a slot or a groove or likewise. A slot-like guide may be manufactured in an inexpensive manner. A projection may be provided or integrally formed on the container part, as a guide element cooperating with the guide path. This

is an inexpensive and efficient embodiment of the teaching according to the invention, but the concept of the invention is not limited to this embodiment.

Preferably, in each case one guide element is provided on oppositely lying sides of the mixing capsule, and in each case one guide path is provided on oppositely lying sides of the sleeve. This embodiment has the advantage that a good guiding of the sleeve is ensured.

According to a preferred embodiment, a movable displacement body is provided in the first chamber, which fits into the second chamber with a positive fit. The capsule has the advantage that with the displacement body, the membrane may be pierced through in the direction of the fluid space, and due to this no membrane part may get into the mixing space. Furthermore, only a slight force is required in order to destroy the membrane. Accordingly, no threads need to be provided with the receptacle part and the piston. A further advantage is the fact that with the activation procedure, i.e. when the components stored in the first and in the second chamber are brought together, the volume of the first chamber acting as a mixing chamber remains equal and no excess pressure arises. On activation, the displacement body displaces the fluid components out of the first chamber. Usefully, the displacement body fits essentially into the through-opening at the end-face of the piston, i.e. the outer diameter of the displacement body corresponds to the inner diameter of the through-opening. This has the advantage that with an inserted displacement body, the membrane is held by this and thus no membrane parts may get into the mixing space. Preferably, the displacement body may be displaced by way of an activation pin which closes the ejection nozzle in the non-activated condition.

Advantageously, the displacement body has a shape which is complementary to the first chamber. By way of this, the displacement body may displace the liquid present in the second chamber into the mixing space (first chamber). A further advantage is the fact that the membrane is fixed in the second chamber by the displacement body. Usefully, the displacement body in the activated condition of the capsule is accommodated in the second chamber essentially flush with the end-face of the piston. This has the advantage that the finished mixture may be pressed practically completely out of the capsule with the piston.

Although the second chamber may basically be a package formed of a film, the liquid is preferably accommodated in a shape-stable second chamber formed on the piston. According to a particularly preferred embodiment, the piston itself is designed as a hollow piston with a fluid receptacle, or such is integrally formed on the piston. This is a simple design and may accordingly be manufactured in an inexpensive manner. Advantageously, a membrane covering the through-opening is deposited or may be deposited at the front onto the end-face of the piston. Since the piston wall has a certain wall thickness, the film may be easily welded onto the end-face. At the same time there exists practically no danger of fluid being able to evaporate on welding. Usefully, at least one sealing ring is integrally formed at the front on the piston casing. This ensures the sealing of the mixing chamber defined by the end-faces of the container part and of the piston.

The front part of the displacement body is preferably designed as a point. By way of this, it becomes possible to pierce the film closing the second chamber with a low force effort. According to a preferred embodiment, an overflow channel or a conduit is provided, preferably running in the axial direction. On introduction of the displacement body, the overflow channel may prevent a pressure build-up in the second chamber, since the fluid may easily flow away. Furthermore, the overflow channel may be dimensioned such that viscous or semi-liquid media may also be brought out of the fluid receptacle.

The activation pin may basically be integrally formed directly on the displacement body. In this case, the displacement body together with the activation pin may be inserted into the container part from the rear. A predetermined break location on the base of the displacement body permits the activation pin, after the mixing procedure, e.g. by way of rotation, to be separated from the displacement body and retracted. According to a preferred embodiment however, the displacement body and the activation pin are designed as separate parts. With this embodiment, usefully a recess serving as a guide for the activation pin is provided on the base of the activation body. The displacement body may be placed onto the activation pin which is previously introduced into the ejection nozzle. Usefully, the displacement body is a solid body with a flat base. The solid body may be of plastic and have a shape which is complementary to the fluid receptacle. Advantageously, the solid body fits into the second chamber roughly flush with the end-face of the piston.

According to a particularly preferred embodiment, the activation pin has such a length that the piston of the filled mixing capsule may be pushed back by a certain distance from a filled position into a mixing position. A vacuum in the mixing chamber results on account of the increase in the volume. This has the advantage that a degassing of the mixture takes place on mixing. Thus no formation of bubbles occurs on pressing out the mixture.

The subject-matter of the present invention is also a method for the activation of a mixing capsule which accommodates at least two components of a multi-component mixture, with which method the initial components stored in separate chambers of a mixing capsule are brought together, said method being characterised in that a sleeve cooperating with the activation part is arranged on the mixing capsule, and is guided on the mixing capsule in a movable manner such that on removal of the sleeve, the activation part is forcibly displaced. Thereby, the sleeve is advantageously displaced in an activation direction forwards and backwards relative to the mixing capsule along a U- or V-shaped guide part.

The invention is hereinafter explained by way of example and by way of one embodiment of a mixing capsule with reference to the figures. There are shown in:

- Figure 1: a mixing capsule in a longitudinal section and in the filled position (initial condition);
- Figure 2: the capsule of Figure 1 in the activated condition (mixing position);
- Figure 3: the capsule of Figure 2, after the activation pin has been retracted (pressing-out position);
- Figure 4: a conical activation part;
- Figure 5: a second embodiment of a mixing capsule with an activation part, which may be fixed on the container base; and
- Figure. 6: one embodiment of the displacement body with annular projections on the base, in a perspective view;
- Figure. 7: a first embodiment of a forced activation means according to the invention, in the form of a sleeve which may be placed onto the mixing capsule, with a slot-like

guide path and with a projection provided on the mixing capsule, in a perspective view;

- Figure 8: the sleeve of the first embodiment form, in a perspective view;
- Figure 9: a second embodiment of a forced activation means according to the invention, with a guide path designed as a groove, in a perspective view;
- Figure 10: a mixing capsule according to the invention and according to the Figures 1 to 6, with the forced activation means in the initial position;
- Figure 11: the mixing capsule of Fig. 9 with the forced activation means in the activation position.

Figures 1 to 4 show a mixing capsule 1 with an outer container part 13 and a piston 15 which is accommodated in the container part 13. The piston 15 is axially displaceable in the container part 13 and in Figure 1 is located in the initial position or filled condition, and in Figure 2 in the mixing position (activated condition of the capsule). The container part 13 is cylindrical and has an opening 16 for introducing the piston 15 and an end-face 17 on which an ejection nozzle 19 is integrally formed. With an assembled mixing capsule, a first chamber 35 is defined between the piston 15 and the end-face of the receptacle 13, and this serves as a mixing space. An annular groove 21 is provided at the rear end of the container part 13 at the outside. The annular groove 21 serves for accommodating a jaw of a known pressing-out tool.

A second chamber 23 is provided on or in the piston 15. According to the shown advantageous embodiment, the piston 15 has the shape of a conical, pyramidal or cylindrical beaker or cavity with an opening 25 directed to the end-face 17, and with an inner space 27. The inner space 27 serves for receiving the fluid or at least flowable components of a two-component resin, and serves as a shape-stable liquid receptacle. In the non-activated condition, the through-opening 25 is closed with a film or membrane 29. The film in the known manner may be welded onto the end-face 31 of the piston 15. One or more ring seals 32 are integrally formed on the piston casing for sealing the piston 15 with respect to the container part 13. The first seal 32 is located at the frontmost piston edge. Two further seals 32a, 32b are located at a distance to the first seal 32.

A displacement body 33 is applied into the mixing space 35 between the end-face of the piston 15 and the end-face of the container part 13. The displacement body 33 has a shape which is complementary to the inner space 27 of the piston 15. The displacement body 33 is axially displaceable in the container part 13 by way of an activation pin 37 which is accommodated in the ejection nozzle 19 before the activation of the mixing capsule. The length of the activation pin 37 is at least so long that the displacement body 33 may be inserted completely into the second chamber 23. The activation pin 37 has a head 38 which serves as an abutment. The head 38 has an undercut 40 in which the front edge of the ejection nozzle is accommodated when the activation pin 37 has been completely inserted.

The displacement body 33 has a round recess 41 on the base 45. The recess 41 serves for receiving the front part of the activation pin 37. The front part of the activation pin 37 and the recess 41 are advantageously created such that a frictional fit is realised. The displacement body 33 may be fixed in the mixing space of the non-activated capsule 11 by way of this. However, it is also conceivable for the displacement body 33 to be provided with radially projecting arms so that it is guided in the container part 13. An overflow channel 43 is present in the casing of the

displacement body (Fig. 4) in order to ensure an unhindered flow of the liquid present in the second chamber into the mixing space 35.

One modified embodiment of the displacement body 33 envisages providing the same means on the base 45 in order to releasably fix the displacement body 33 on the container part 13. The means - as are shown in Fig. 5 and 6 - may be annular projections 47 which may lock into an annular groove 49 on the container base 51. The annular groove 49 is provided on the through-opening of the ejection nozzle 19. The shown embodiment has the advantage that on filling the capsule, the displacement body may firstly be inserted into the container part 13 and that then an unintended falling-out or slipping is prevented due to the friction fit connection between the annular groove 49 and the projections 47.

According to the invention, a forced activation means is provided which ensures that the mixing capsule may not be applied without prior activation. The forced activation means preferably comprises a cylindrical sleeve 53 which may be placed onto the mixing capsule 11 (Figures 7 to 11). V-shaped guide paths 57 are provided on the casing 55 of the sleeve 53. The guide paths 57 in each case have a first open end 59 at the edge 51 of the sleeve, through which a guide element 63 integrally formed on the mixing capsule 11 may be introduced, and a second end 65 which serves as an abutment for the guide element 63 (Fig. 7 and 8). The sleeve 53 at the front end has an abutment surface 67 which may cooperate with the end of the activation pin 37 which projects out of the ejection nozzle. The sleeve may be tapered into a point 68 as is shown in Figures 7 to 11.

In the initial or transport condition of the activation means shown in Fig. 7 and 10, the guide element 63 formed as a projection is located at the second end 65 of the guide path 57. For removing the sleeve 53, this in the activation direction (arrow 69) must firstly be displaced forwards and then backwards, as this is defined by the course of the guide path. Thereby, the activation pin 37 arranged in the ejection nozzle 19 is pushed into the mixing capsule. On displacement, the displacement body 33 bearing on the activation pin 37 is pushed into the second chamber 23. With this action, the flowable mass located in the second chamber 23 is displaced into the first chamber 35.

The sleeve shown in Figure 9, in contrast to the sleeve of Figure 8, has a U-shaped guide path 57a. Furthermore the guide path 57a is not designed as a slot, but as a groove.

The mixing capsule according to the invention is prepared and applied as follows:

The displacement part 33 is firstly applied into the container part 13 and the activation pin 37 is introduced through the ejection nozzle 19. After this, the sleeve 53 is placed onto the mixing capsule 11 and brought into the initial position, i.e. the projection 63 is located at the second end 65 of the guide path 57. Subsequently, the displacement body 33 is applied into the container part in a manner such that the front part of the activation pin 37 is accommodated in the recess 41. After this, the one artificial resin component (powder-like or fluid) may be filled into the container part 13 which is directed in a perpendicular manner.

The piston 15 in which the fluid receptacle 23 is formed is filled with the desired liquid or flowable mass in a separate operation, and is sealingly closed with a membrane. These processes may take their course in an automated manner. The filling of the piston 15 through the through-opening 25 and the welding of the film to the piston edge by way of a hot punch are simple to accomplish from above.

Subsequently, the piston 15 is applied into the receptacle part 13. In order to prevent a pressure build-up in the mixing chamber, a wire may be applied between the container wall and the piston 15, in order to discharge air out of the mixing chamber to the surroundings on introduction of the piston. The wire may be removed again after this. The position of the piston 15 in the container part 13 is preferably selected such that the piston 15 of the filled mixing capsule may still be displaced a certain distance to the rear from an initial position (Fig. 1) into a mixing position (Fig. 2).

For manufacturing the multi-component mixture, it is necessary to firstly remove the sleeve 53. This is by way of pushing forwards and backwards as well as rotating the sleeve relative to the mixing capsule. With this procedure, the displacement body 33 is firstly pushed into the second chamber 23 by way of the activation pin 37. Thereby, the sharp penetration body 33 penetrates the film 29 in the middle and presses the fluid artificial resin component present in the second chamber 23 into the mixing space 35. With a suitable length of the activation pin, the complete piston 15 may further be displaced into a mixing position. In the mixing position which is then assumed, the capsule 11 is shaken in a known shaking apparatus during a certain time span. The activation pin 37 is subsequently retracted and the finished, viscous artificial resin mixture is pressed out with a known pressing-out pistol.

A mixing capsule for a two-component mixture has a preferably cylindrical container part 13 with an ejection nozzle 19 integrally formed on the end-face. A piston is axially displaceably guided in the container part. A through-opening is provided in the end-face of the piston, to which a fluid receptacle connects. A membrane closes the through-opening in the non-activated condition of the capsule. The cavity between the end-face of the container part and the end-face of the piston forms a mixing space. A movable displacement body is provided in the mixing space. The displacement body is displaceable by way of an activation pin which closes the ejection nozzle in the non-activated condition. A forced activation means is provided so that the mixing capsule may not be unintentionally activated, but it needs to be activated on use. The means is based on a sleeve which may be placed onto the mixing capsule and which ensures an activation of the mixing capsule on withdrawal. For this purpose, at least one U-shaped or V-shaped guide path and a guide element engaging into the guide path is formed on the sleeve and the mixing capsule in each case, so that the sleeve 53 for placing onto the mixing capsule or with its removal must be displaced along the guide path 57, 57a in the activation direction 69.

## List of reference numerals

11	mixing capsule
13	container part
15	piston
16	opening in the container part 13 for introducing the piston 15
17	end-face of the container part
19	ejection nozzle
21	annular groove
23	second chamber (fluid receptacle)
25	through-opening (passage opening)
27	inner space
29	film or membrane
31	end-face of the piston
32	sealing ring or sealing bead
32a, 32b	second and third sealing ring or sealing bead
33	displacement body
35	first chamber (mixture space)
37	activation pin
38	head of activation pin
40	undercut on the head 38
41	recess
43	overflow channel
45	base of the displacement body 33
47	projections, e.g. annular
49	annular groove
51	container base
53	sleeve
55	casing
57	guide paths
59	first open end of the guide paths
61	edge
63	guide element
65	second end of the guide paths
67	abutment surface
68	tapered front end of the sleeve 53
69	activation direction (arrow)